

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF APPEALS AND INTERFERENCES

In re application of	)	
JOLINDE MACHTELD VAN DE GRAAF	)	
Serial No. 10/536,532	)	Group Art: 1793
Filed May 26, 2005	)	Examiner: Timothy C. Vanoy
PROCESS FOR REMOVING SULPHUR	)	July 8, 2008
COMPOUNDS INCLUDING HYDROGEN	)	
SULPHIDE AND MERCATANS FROM	)	
GAS STREAMS	)	

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COMMISSIONER FOR PATENTS  
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Sir:

APPEAL BRIEF

This brief is filed in support of Applicant's appeal from the Examiner's action dated February 15, 2008, finally rejecting claims 1-20 of the above-identified U.S. patent application. A notice of appeal from this decision was filed by Applicant on May 15, 2008.

Please charge the fee for filing this brief to Shell Oil Company Deposit Account No. 19-1800.

It is respectfully requested that the Board reverse the final rejection of claims 1-20 of the above-identified application for the reasons discussed below.

REAL PARTY IN INTEREST

The invention described and claimed in the above-identified patent application is assigned to Shell Oil Company, which is the real party in interest in the present appeal.

## RELATED APPEALS AND INTERFERENCES

Appellant and Appellant's legal representatives are not aware of any related appeals or interferences.

## STATUS OF CLAIMS

Claims 1-20 have been rejected and are the subject of this appeal. A copy of the claims on appeal can be found in the Claims Appendix.

## STATUS OF AMENDMENTS

Since no objections were raised by the Examiner to the amendments proposed in Appellant's communication of December 20, 2007, Appellant assumes the amendments were entered.

## SUMMARY OF CLAIMED SUBJECT MATTER

The following is a summary of the claimed subject matter with specific reference to the portions of the specification that support the various claim limitations.

Independent claim 1 claims a process for removing hydrogen sulphide and mercaptans from a gas stream having a high ratio of mercaptans to hydrogen sulphide, which involves washing the gas stream with an aqueous washing solution comprising 10 to 45 wt% (based on the total solution) of water, 10 to 40 wt% (based on the total solution) of a physical solvent, and 20 to 60 wt% (based on the total solution) of an amine to yield a washed gas stream (specification, page 4, line 30 to page 5, line 7, and page 5, lines 18-21), followed by removing mercaptans from the washed gas stream by means of molecular sieves (specification, page 5, lines 7-9). The amount of mercaptans removed by the aqueous wash stream is between 60 and 96%, while the amount of mercaptans removed by the molecular sieves is from 4 to 40% (specification, page 5, lines 9-13).

Independent claim 14 claims a process for removing hydrogen sulphide and mercaptans from a gas stream having a high ratio of mercaptans to hydrogen sulphide, which involves washing the gas stream with an aqueous washing solution comprising 10 to 45 wt% of water, 10 to 40 wt% of a physical solvent, and 20 to 60 wt% of an amine, wherein each wt% is based on the total weight of the aqueous washing solution, to remove 60 to 96% of the total mercaptans from gas stream, and to remove from 4 to 40% of the mercaptans from the washed gas stream using molecular sieves (specification, page 4, line 30 to page 5, line 13, and page 5, lines 18-21). Claim 14 also recites that the treated gas stream have an amount of mercaptans less than

that the feed gas stream and in the range from 5 ppmv to 60 ppmv, which limitation is supported in the specification on page 9, lines 11-13 .

Dependent claim 9 , which is argued separately, contains the limitation that the washed gas stream obtained from the washing step is cooled to a temperature between 5 and 45 °C, where after any condensate is separated from the washed stream. This claim is supported by the disclosure on page 8 of the specification, lines 27-31.

Dependent claim 16, which is argued separately, contains the limitation of cooling the washed gas stream and separating condensate therefrom prior to the using step of the process. This claim is also supported by the disclosure on page 8 of the specification, lines 27-31.

Dependent claim 12, which is argued separately, contains the limitation that the removing step is carried out at a pressure between 15 and 90 bara. This claim is supported by the disclosure on page 9 of the specification, lines 21-23.

#### GROUND OF REJECTION TO BE REVIEWED ON APPEAL

The rejection of claims 1-20 under 35 U.S.C. §103 (a) as being unpatentable over GB 2,275,625 to Taylor.

#### ARGUMENT

The rejection of claims 1-20, under 35 U.S.C. §103(a) as being unpatentable over GB 2,275,625 to Taylor is erroneous and should be reversed.

The present invention is directed to special problem that exists in trying to remove both mercaptans and hydrogen sulfide from gas feed streams having high ratios of mercaptans to hydrogen sulfide, e.g., a ratio of mercaptans (expressed as ppmv) to hydrogen sulfide (expressed as vol%) of at least 50, preferably at least 100, more preferably at least 200 (specification, page 6, lines 9-23). It has been found that washing the gas stream with a particular aqueous washing solution comprising 10 to 45 wt% water, 10 to 40 wt% of a physical solvent and 20 to 60 wt% amine, removes most of the hydrogen sulfide (e.g., at least 90%, preferably at least 95% and more preferably at least 98% of the hydrogen sulfide) and 60 to 96% of the mercaptans, allowing the remaining minor amount of hydrogen sulfide and 4% to 40% mercaptans to be removed in a second removal step by means of molecular sieves (specification, page 3, lines 21-31, page 4, line 30 to page 5, line13, and page 9, lines 7-10).

The fact that the gas stream being treated by the present method has a high ratio of mercaptans to hydrogen sulfide making it very difficult to treat using conventional treatment methods, and the particular aqueous washing solution comprising 10 to 45 wt% water, 10 to 40 wt% of a physical solvent and 20 to 60 wt% amine, which was found to be highly effective in removing mercaptans and hydrogen sulfide from such difficult to treat gas streams, are recited as limitations in independent claims 1 and 14, and are being relied on for patentability.

The limitations in dependent claims 9 and 16 that the washed stream be cooled to remove water prior to being contacted with the solid absorbent, and the limitation in dependent claim 12 that the removing step be carried out at the relatively high pressure of between 15 and 90 bara, are being relied on to provide additional bases for the patentability of these claims.

Turning now to the reference relied on by the Examiner for the rejection (GB 2,275,625 to Taylor), Taylor discloses a two step method for removing hydrogen sulfide and organic sulfur compounds, such as carbonyl sulfide and mercaptans, from a gas stream. An example of a gas stream that can be treated by the method disclosed in Taylor is natural gas, which Taylor discloses typically contains up to 500 ppmv mercaptans. (Page 1, lines 1-12). Taylor does not disclose any specific concentration for hydrogen sulfide contained in the natural gas treated by the disclosed method. Thus, there is no way to know, or to calculate, the ratio of mercaptans to hydrogen sulfide in natural gas treated by Taylor. For example, if the natural gas stream in Taylor contained 500 ppmv mercaptans (the upper amount said to found in a typical natural gas stream) and 20 vol% hydrogen sulfide, the ratio of mercaptans to hydrogen sulfide as defined on page 6 of the specification, would be only 25 (i.e., 500/20). This is well below the high mercaptan to hydrogen sulfide ratio of at least 50, preferably at least 100, and more preferably at least 200, present in the gas streams treated by applicant's method (see page 6 of the specification, lines 16-21).

Therefore, there is no basis for the statement on page 5 of the subject Office action that "Applicant and Taylor treat the same natural gas stream". Applicant's method and Taylor's method can both be used to treat natural gas. However, the natural gas stream treated by Applicant's method is different from the natural gas stream in Taylor, in that it is specified to have a high ratio of mercaptans to hydrogen sulfide, which makes it more difficult to treat. There is no way to know or calculate the ratio of mercaptans to hydrogen sulfide in the natural gas stream treated by Taylor, since Taylor does not disclose the amount of hydrogen sulfide present in the natural gas treated by his method. The disclosure in Taylor relied on by the Examiner, that typically natural gas contains "up to 500 ppmv of mercaptans" does not provide a basis for calculating the mercaptan to hydrogen sulfide ratio. It is again emphasized that the limitation in

present claims 1 and 14 is expressed in terms of a ratio of mercaptans to hydrogen sulfide, not in terms of a specific amount of mercaptans present in the gas stream. Taylor does not disclose gas streams having high ratios of mercaptans to hydrogen sulfide. The gas streams treated by Applicant's method have high ratios of mercaptans to hydrogen sulfide, which is one of the limitations being relied on for patentability. The amount of mercaptans in Applicant's gas stream can range as high as 1500 ppmv mercaptans, preferably as high as 1000 ppmv mercaptans (specification, page 5, lines 29-33), which is two to three times greater than the upper amount of mercaptans typically found in natural gas. However, it is the ratio of mercaptans to hydrogen sulfide that matters, not the amount of mercaptans.

The first step in the method disclosed in Taylor involves contacting the gaseous stream with a regenerable aqueous absorbent in an absorber to obtain a treated gas and a loaded absorbent which is regenerated. The regenerable aqueous absorbent can be an aqueous solution of a chemical absorbent such as an alkanol amine and a physical absorbent such as sulfolane (Taylor, page 1, lines 15-18). There is no disclosure in Taylor of the concentrations of chemical absorbent, physical absorbent or water present in the regenerable absorbent employed in the first step.

The second step in the method disclosed in Taylor involves contacting the treated gas with a solid absorbent to remove organic sulfur compounds from the treated gas and to obtain a purified gas and a loaded solid absorbent which is regenerated (Taylor, page 1, line 28 to page 2, line 1). Taylor teaches that suitable solid absorbents are molecular sieves, in particular zeolites of the types 5A and 13X ( Taylor, page 2, lines 6-8).

There is no disclosure in Taylor of cooling the treated gas stream from the first step to remove water prior to contact with the solid absorbent. To the contrary, Taylor uses the solid absorbent to remove both mercaptans and water and then removes the water from the solid absorbent with regeneration off-gas. It is the regeneration off-gas after leaving the absorber that is cooled to remove water, not the treated gas before entering the absorber (Taylor, page 4, lines 12-18).

Also, there is no disclosure in Taylor of operating the first or second absorption steps at high pressures, e.g. between 15 and 90 bara, which permits flashing of any absorbed carbon dioxide at high pressure, reducing re-compression requirements, which is important if the carbon dioxide is to be re-injected (specification, page 4, lines 24-29). Taylor contains no teaching or suggestion of using high pressures in either step of the disclosed process.

While the present method and the method in Taylor both involve generally similar steps, the present method is directed to a different and much more difficult to treat gas stream, i.e., a

gas stream having a high ratio of mercaptans to hydrogen sulfide. In order to remove mercaptans and hydrogen sulfide from these difficult to treat gas streams, applicant employs a specific washing solution having a particular composition, i.e., 10 to 45 wt% water, 10 to 40 wt% of a physical solvent and 20 to 60 wt% of an amine. In its most relevant aspects Taylor only teaches that a suitable aqueous regenerable absorbent comprises an aqueous solution of a chemical absorbent which contains a physical absorbent (Taylor, page 1, lines 15-18). Taylor does not disclose any specific absorbent compositions and offers no guidance as to amounts of water, chemical absorbent, or physical absorbent that should be used in the regenerable aqueous absorbent used to treat typical natural gas streams, much less the difficult to treat gas streams having high ratios of mercaptans to hydrogen sulfide treated by applicant's process.

Appellant will now address some of the specific comments/arguments made by the Examiner in the subject Office action in response to Applicant's arguments submitted with the Amendment filed December 20, 2007.

The Examiner found Applicant's argument that Taylor does not recognize the treatment of gas streams that having a particularly high concentration of mercaptan to hydrogen sulfide non-persuasive, since according to the Examiner "Applicant and Taylor treat the same natural gas stream (compare the limitations of Applicant's claim 5 to the disclosure set forth in pg.1 lns.9-11 in the Taylor publication, both of which disclose the gas stream being treated is natural gas)."

While Applicant's method and Taylor's method can both be used to treat natural gas streams, this does not mean they treat the "same natural gas stream". The natural gas stream treated by Applicant's method must have a high ratio of mercaptans to hydrogen sulfide, (i.e., a ratio of the amount of mercaptans (expressed as ppmv) to the amount of hydrogen sulfide (expressed as vol%) of at least 50, preferably at least 100, more preferably 200 (See specification, page 6, lines 16-21). Taylor does not specify the ratio of mercaptans to hydrogen sulfide in the typical natural gas streams treated by his method, nor can the ratio be calculated, since Taylor does not disclose the concentration of hydrogen sulfide in the natural gas streams he treats. As discussed above, a disclosure that typically natural gas contains "up to 500 ppmv mercaptans", does not mean the ratio of mercaptans to hydrogen sulfide in such a natural gas stream will be high, since this ratio also depends on the amount of hydrogen sulfide present in the stream. Appellant's claims are directed to natural gas and other gas streams having a high ratio of mercaptans to hydrogen sulfide, e.g., at least 50 as specified in claim 5 through its dependency on claim 4. Therefore, there is no basis for the statement on page 5 of the subject Office action that "Applicant and Taylor treat the same natural gas stream".

In the middle of page 5 of the subject Office action it is stated that: "No distinction is seen or has been shown between the washing solution that the Applicant uses and the process of Taylor uses: please compare the limitations set forth in Applicants' independent claims of limiting the washing solution to contain: (1) water; (2) amine and (3) a physical solvent to the disclosure set forth on pg.1 Ins. 15-18 in the Taylor publication which sets forth that their washing solution also contains an aqueous solution of an amine together with a physical sorbent (such as sulfolane)."

The foregoing statement ignores the fact that independent claims 1 and 14 not only specify the individual components comprising the aqueous washing solution employed in present method, but also the concentrations of the components, i.e., 10 to 45 wt% of water, 10 to 40 wt% of a physical solvent and 20 to 60 wt% of an amine. It is this particular washing solution, having this particular concentration of components, that has been found to be highly effective in treating gas streams having a high ratio of mercaptans to hydrogen sulfide.

On page 4 of the subject Office action the Examiner dismisses Applicant's discovery of a highly effective composition for treating gas streams having high ratios of mercaptans to hydrogen sulfide as nothing more than optimization of the process parameters taught Taylor and arrived at by Applicant's through routine experimentation. The Examiner's position ignores the fact that Taylor does not contain any disclosure regarding the concentrations of the components employed in the regenerable aqueous absorbent used in the first step of his process. Moreover, Taylor is directed to treating typical natural gas streams, not difficult to treat gas streams having high ratios of mercaptans to hydrogen sulfide to which the present invention is directed. Therefore, Applicant's discovery of a particular composition having a particular concentration of ingredients to treat gas streams having a high ratio of mercaptans to hydrogen sulfide, is not mere optimization of the process parameters taught in Taylor. Taylor does not teach any process parameters regarding concentration ranges for the components in his regenerable aqueous absorbent, and does not teach treating gas streams having high mercaptan to hydrogen sulfide ratios.

Because Taylor does not disclose any specific compositions, or concentrations for the components of his regenerable aqueous absorbent, Applicant is unable to make a comparison of Taylor's aqueous absorbent to Applicant's aqueous washing solution. The fact that Taylor does not even provide enough information about the concentrations of his aqueous absorbent to make a comparison, is evidence that Applicant is not merely optimizing Taylor's teachings. Taylor is silent as to concentration ranges. The particular compositions having the

concentrations specified in claims 1 and 14, are the result of discovery. Not optimization of Taylor's teachings.

On page 6 of the subject Office action again states that no distinction is seen or can be shown between the natural gas that Applicant treats and the natural gas that Taylor treats. As discussed above, the natural gas that Applicant treats has a high ratio of mercaptans to hydrogen sulfide, i.e., ratios of at least 50 preferably at least 100, more preferably at least 200. The natural gas that Taylor treats contains mercaptans and hydrogen sulfide, but appears to be typical natural gas, rather than natural gas having a high ratio of mercaptans to hydrogen sulfide. Taylor does teach that typical natural gas can have up to 500 ppmv mercaptans. But the ratio of mercaptans to hydrogen sulfide in Taylor is unknown and cannot be calculated since Taylor does not disclose the concentration of hydrogen sulfide in the natural gas he treats. Therefore, the distinction between the natural gas Applicant treats and that Taylor treats lies in the ratio of mercaptans to hydrogen sulfide. A high ratio in the case of Applicant's natural gas stream vs. a low or unknown ratio in the case of Taylor's natural gas stream.

On page 6 of the subject Office action item d), the Examiner finds Applicant's argument that Taylor does not teach the limitations claims 9 and 16 not persuasive, because in the Examiner's view it would be obvious to remove water from the washed gas by any known means "because of the expected advantage of minimizing the sorption of water into zeolite molecular sieve (which would, in turn, minimize the binding capacity of the zeolite for the sulfur species by occupying sorption sites within the zeolite that would otherwise be occupied by the sulfur species), as suggested on pg. 4 Ins. 12-18 in the Taylor publication."

Appellant submits the disclosure cited by the Examiner on page 4, lines 12-18 of Taylor, rather than suggesting removing water from the washed gas prior to contact with the solid absorbent, suggests precisely the opposite. The quoted portion of Taylor teaches that the solid adsorbent can in addition to removing mercaptans remove water from the treated gas, and that water should be removed from the solid absorbent using regeneration off-gas. Finally, water is removed from the regeneration off-gas by cooling and separating liquid water.

Taylor does not teach or suggest there is an advantage to removing water from the treated gas prior to contacting the gas with the solid absorbent. To the contrary, Taylor suggests using the solid absorbent to remove water, and then using regeneration off-gas to remove water from the solid absorbent. This may be a more efficient way of handling water in Taylor's process, especially if the amount of water in the treated gas is low. In any case, Taylor does not teach or suggest cooling the washed gas stream and separating condensate prior to contact with the molecular sieve as recited in claims 9 and 16. The advantage of removing water from



the treated gas prior to contact with the solid absorbent is taught in present specification, which the Examiner cannot use for the rejection. It is not taught or suggested by Taylor.

Finally, Taylor does not teach or suggest operating the disclosed process at high pressures in the range between 15 and 90 bara as recited in present claim 12. In fact, Taylor is silent as to the pressures in either the first absorption step utilizing the regenerable aqueous absorbent, or the second absorption step using a solid absorbent. Thus, claim 12 is believed to be patentable over the cited reference for this additional reason.

## SUMMARY

Applicant's method is directed to gas streams having a high ratio of mercaptans to hydrogen sulfide, which is a limitation in claims 1 and 14. While Taylor teaches that typical natural gas streams may contain up to 500 ppmv mercaptans, Taylor does not disclose the concentration of the hydrogen sulfide contained in the natural gas treated by his method. Thus, it is erroneous for the Examiner to contend that Taylor treats "the same natural gas" as Applicant, or that the natural gas treated by Taylor has a high mercaptan/hydrogen sulfide ratio. There simply is no way to know, or to calculate, the ratio of mercaptans to hydrogen sulfide in natural gas treated by Taylor based on the disclosure that typically natural gas contains up to 500 ppmv mercaptans.

Applicant's method employs a particular washing solution having a specified concentrations of components. While Taylor teaches a regenerable aqueous absorbent with similar components, Taylor does not disclose any concentrations of the components employed in his regenerable aqueous absorbent. Therefore, Applicant's discovery of a particular composition having a particular concentration of ingredients to treat gas streams having a high ratio of mercaptans to hydrogen sulfide, is not mere optimization of the process parameters taught in Taylor, since Taylor does not teach any concentration ranges that one could optimize.

Thus, Taylor fails to disclose or teach at least two important limitations recited in present claims 1 and 14, i.e., gas streams with high mercaptan to hydrogen sulfide ratios, and a particular washing solution comprising specific concentrations of components.

Taylor fails to disclose other features that are claimed in the dependent claims of the applicant's invention. For instance, Taylor does not disclose the limitations of claims 9 and 16 that are directed to cooling of the washed gas stream and removal of condensate therefrom prior to passing the washed gas stream to the molecular sieve adsorption step. In marked contrast, Taylor discloses using the solid absorbent in the second step to remove water as well as mercaptans and subsequently removing water from the solid absorbent with the regeneration

off-gas. Also, Taylor does not teach the limitation in claim 12 that the removing step is carried out at a pressure of between 15 and 90 bara. In fact, Taylor doesn't contain any teachings regarding the pressure in either the first or second step of his process.

Considering that the Taylor reference fails to disclose, either specifically or inherently, several limitations in independent claims 1 and 14, and fails to disclose additional limitations in dependent claims 9, 12 and 16, and since there is no cited reference that is used to modify Taylor in order to supply the missing limitations, the claimed invention is clearly unobvious over this reference.

#### CONCLUSION

For all the above stated reasons, claims 1-20 of the present application are believed to be patentable over the cited reference. Accordingly, the action of the Examiner in finally rejecting these claims should be reversed, which action is respectfully requested.

Respectfully submitted,

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## CLAIMS APPENDIX

1. A process for the removal of hydrogen sulphide and mercaptans from a gas stream having a high ratio of mercaptans to hydrogen sulphide and comprising hydrogen sulphide and mercaptans, wherein the process comprises: washing the gas stream with an aqueous washing solution comprising 10 to 45 wt% (based on total solution) of water, 10 to 40 wt% (based on total solution) of a physical solvent, and 20 to 60 wt% (based on total solution) of an amine, to yield a washed gas stream; followed by removing mercaptans from the washed gas stream by means of molecular sieves, in which process the amount of mercaptans removed by the aqueous washing solution from the gas stream is between 60 and 96 % (of total removed mercaptans in steps one and two), and the amount of mercaptans removed by the molecular sieves is between 4 and 40 % (of total removed mercaptans in step one and two).
2. A process according to claim 1, in which the gas stream comprises 0.05 to 20 vol% hydrogen sulphide, 10 to 1500 ppmv mercaptans and 0 to 40 vol% carbon dioxide.
3. A process according to claim 2, in which the gas stream comprises hydrogen sulphide in an amount between 0.15 and 0.6 vol%.
4. A process according to claim 3, in which the ratio of the amount of mercaptans (expressed as ppmv) to the amount of hydrogen sulphide (expressed as vol%) in the gas stream is at least 50.
5. A process according to claim 4, in which the gas stream is natural or associated gas.
6. A process according to claim 5, in which the physical solvent is sulfolane.
7. A process according to claim 6, in which the amine is a secondary or tertiary amine.
8. A process according to claim 7, in which the aqueous washing solution comprises 20 to 35 wt% based on total solution of water, 20 to 35 wt% of a physical solvent and 40 to 55 wt% of an amine.

9. A process according to claim 8, in which the washed gas stream obtained in the washing step is cooled to a temperature between 5 and 45 °C, where after any condensate is separated from the washed gas stream.

10. A process according to claim 9, in which the washing step is carried out at a temperature of at least 20 °C and at a pressure between 15 and 90 bara.

11. A process according to claim 10, wherein the removing step uses a crystalline molecular sieve of the type selected from the group of zeolite type A and zeolite type X.

12. A process according to claim 11, wherein the removing step is carried out at a pressure between 15 and 90 bara.

13. A process according to claim 12, in which the regeneration gas of the second step containing mercaptans is remixed with the starting gas stream or is treated in a dedicated absorber.

14. A process for the removal of hydrogen sulfide and mercaptans from a gas stream that comprises hydrogen sulfide and a mercaptan and having a high ratio of mercaptans to hydrogen sulfide, wherein said process comprises:

washing said gas stream with an aqueous washing solution, comprising from 10 wt% to 45 wt% water, from 10 wt% to 40 wt% physical solvent, and from 20 wt% to 60 wt% amine, wherein said wt% is based on the total weight of said aqueous washing solution, to remove from said gas stream between 60 % to 96% of the total mercaptans removed from said gas stream by said process to thereby yield a washed gas stream; and

using a molecular sieve to remove from said washed gas stream a portion of the mercaptans contained in said washed gas stream amounting to between 4% to 40% of the total mercaptans removed from said gas stream by said process to thereby yield a treated gas stream having an amount of mercaptans that is less than that of said gas stream and in the range of from 5 ppmv to 60 ppmv.

15. A process as recited in claim 14, wherein said gas stream comprises from 0.05 to 20 vol% hydrogen sulfide, from 10 to 1500 ppmv mercaptan, and from 0 to 40 vol% carbon dioxide.

16. A process as recited in claim 15, further comprising: cooling said washed gas stream and separating condensate therefrom prior to said using step of said process.

17. A process as recited in claim 16, wherein said using step of said process includes the use of at least two mol sieve reactor vessels each of which contains a bed of said molecular sieve wherein at least one of said mol sieve reactor vessels is operating in an adsorbing mode and at least one of said mol sieve reactor vessels is operating in a desorption mode.

18. A process as recited in claim 17, further comprising:  
utilizing a portion of said treated gas stream as a regeneration gas for regenerating said bed of molecular sieve of said at least one of said mol sieve reactor vessels operating in said desorption mode to yield a regenerating gas containing mercaptans.

19. A process as recited in claim 18, further comprising: mixing said regenerating gas containing mercaptans with said gas stream that undergoes said washing step.

20. A process as recited in claim 19, wherein said physical solvent is sulfolane.

## EVIDENCE APPENDIX

None

## RELATED PROCEEDINGS APPENDIX

None